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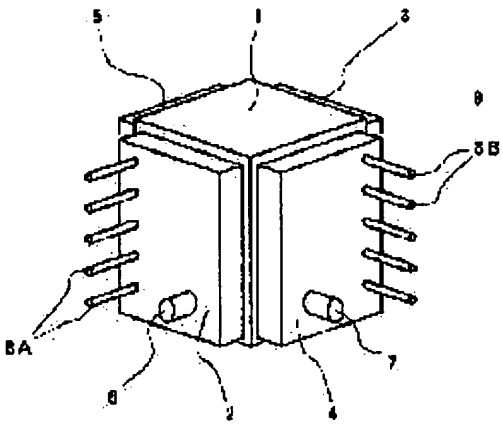
(54) LAYERED FUEL CELL POWER GENERATION DEVICE

(57)Abstract:

PURPOSE: To provide a layered fuel cell power generation device by which gas is uniformly substituted with purge gas of a small flow rate in a large number of unit cells constituting a fuel cell layered body.

CONSTITUTION: A fuel inlet manifold 2 having a fuel inlet nozzle 6 is arranged on one of opposed side surfaces of a fuel cell layered body 1 formed by layering plural unit cells, and a fuel outlet manifold 3 having a fuel outlet nozzle is arranged on the other. An air inlet manifold 4 having an air inlet nozzle 7 is arranged on one of the other opposed side surfaces, and an air outlet manifold 5 having an air outlet nozzle is arranged on the other. Fuel gas is supplied to the fuel cell layered body 1 from a fuel inlet nozzle 6, and air is supplied from the air inlet nozzle 7, and electric power is generated. Purge inlet pipes 8A and 8B are respectively added to the fuel inlet manifold 2 and the air inlet manifold 4, and when operation of a device is stopped, inert gas for gas substitution gas is supplied.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the purge gas supply structure to two or more fuel cell power plants using the fuel cell layered product which comes to carry out the laminating of the single cel, especially fuel cell layered products.
[0002]
[Description of the Prior Art] Drawing 4 is drawing of longitudinal section showing the example of a basic configuration of the fuel cell layered product of the laminating mold fuel cell power plant used conventionally, and shows collectively the manifold which supplies and discharges reactant gas. In drawing, the fuel cell layered product 1 makes the rectangular division plate 46 intervene, carries out two or more layer laminating of the single cel which similarly comes to pinch the rectangular electrolyte layer 41 which consists of a matrix which supported the electrolyte object with a rectangular air pole 42 and a rectangular fuel electrode 43, and is formed in the configuration of a rectangular parallelepiped. Two or more air conduction slots 44 where passage was formed perpendicularly are established in the space in drawing, respectively, and two or more fuel gas conduction slots 45 which have passage in a fuel electrode 43 at the longitudinal direction in drawing which intersects perpendicularly with the passage of the air conduction slot 44 are established in the air pole 42. Opening of the air conduction slot 44 and the fuel gas conduction slot 45 is carried out to the side face of the rectangular parallelepiped-like fuel cell layered product 1, respectively, oxidant gas is sent more from the air inlet nozzle of the air inlet manifold which was perpendicularly built into the space in drawing and which is not illustrated, and it distributes into the air conduction slot 44, and it is discharged from the air outlet nozzle of the air-outlet manifold formed in the side face in which carry out conduction and it faces the back. Similarly, fuel gas is sent more from the fuel inlet-port nozzle 6 of the fuel inlet-port manifold 2, distributes and carries out conduction to the fuel gas conduction slot 45, and is discharged from the fuel outlet nozzle 10 of the after fuel outlet manifold 3.
[0003] Drawing 5 is the mimetic diagram showing the fundamental gas network and the electric system incorporating the above-mentioned fuel cell layered product 1 of a laminating mold fuel cell power plant. The fuel gas reformed and obtained by the reformer 22 in the original fuel is adjusted with the fuel-supply valve 24, and it is sent to the fuel electrode of the fuel cell layered product 1, and oxidant gas is adjusted with the oxidizer supply valve 26, and is sent to an air pole. The power produced between two electrodes according to electrochemical reaction with supply of these reactant gas is taken out by connecting the external load connector 34 to the external load 31.
[0004] thus, in case operation is ended and equipment is suspended in the constituted laminating mold fuel cell power plant While intercepting the external load connector 34 and separating the external load 31, stop the fuel-supply valve 24 and the oxidizer supply valve 26, and supply of fuel gas and oxidant gas is suspended. To coincidence, the fuel system purge valve 27 and the oxidizing agent system purge valve 28 are opened, and it lets the inlet-port nozzle of each inlet-port manifold of the fuel cell layered product 1 pass from the purge gas feeder 23. To a fuel electrode and an air pole For example, it is common that the approach of supplying inactive gas, such as nitrogen and a carbon dioxide, throwing in the discharge ohms-connection machine 32 intermittently in order to make the reactant gas by which occlusion is carried out to the catalyst bed of the electrode of the fuel cell layered product 1 consume at an early stage further, and connecting with the discharge resistance 33 is taken.
[0005]
[Problem(s) to be Solved by the Invention] As mentioned above, in the conventional laminating mold

fuel cell power plant, in case equipment is suspended, it lets it pass, the inlet-port nozzle 6, for example, the fuel inlet-port nozzle, of the inlet-port manifold formed in the fuel cell layered product 1, and inactive gas is supplied as purge gas, internal fuel gas and oxidant gas are removed by purging the interior of the fuel cell layered product 1 (inert gas replacement), and the approach of stopping safely is used.

[0006] However, in the minimum quantity of gas flow which is usually determined according to the flow rate of fuel gas and oxidant gas, and may happen on operation, as for structures, such as an inlet-port manifold formed in fuel gas, and the charging line and the fuel cell layered product 1 of oxidant gas, and a dimension, a line size and a manifold dimension to which pressure loss does not become excessive in the maximum quantity of gas flow which is equally distributed in the direction of a laminating in the inside of each manifold, flows, and may happen are adopted. Therefore, although inert gas replacement is completed at an early stage in the single cel which distribution of the gas inside a manifold becomes unequal in the direction of a laminating, and approaches an inlet-port nozzle in a low flow rate smaller than the minimum quantity of gas flow to which the flow rate of purge gas may happen on the above-mentioned operation when supplying purge gas through an inlet-port nozzle on the occasion of the shutdown of equipment, inert gas replacement stops being able to go on easily in the single cel which is separated from an inlet-port nozzle. When the discharge resistance 33 is connected in this condition and a current is passed, in the late single cel of advance of inert gas replacement, the consumption of gas by which occlusion is carried out will take time amount, and a single cel will be put to high potential in the meantime. On the other hand, in the quick single cel of advance of inert gas replacement, the gas by which occlusion is carried out for a short time is consumed, and whenever it connects the discharge resistance 33, there is a possibility of producing electric corrosion in the base material of an electrode etc. On the other hand, while increasing the flow rate of purge gas, supplying and carrying out inert gas replacement of the purge gas of minimum discharge extent of the reactant gas which may happen on operation, then very a lot of purge gas flow rates being needed and consumption's becoming great, there is a trouble which needs a large-scale purge gas feeder.

[0007] This invention was made in consideration of the trouble like the above, and the purpose has the single cel of a large number which constitute a fuel cell layered product with the purge gas of a few flow rate in offering the laminating mold fuel cell power plant by which inert gas replacement is carried out equally.

[0008]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, it sets to this invention. Carry out the laminating of two or more single cels which come to pinch an electrolyte layer with an air pole and a fuel electrode, and a fuel cell layered product is formed. On the side face of the pair of a fuel cell layered product, an air inlet manifold and an air-outlet manifold A fuel inlet-port manifold and a fuel outlet manifold are built into the side face of other pairs. After carrying out conduction to the air conduction slot which supplied oxidant gas from the air inlet manifold, and was established in the air pole dispersedly, it discharges from an air-outlet manifold. By discharging from a fuel outlet manifold, after carrying out conduction to the fuel gas conduction slot which supplied fuel gas to coincidence from the fuel inlet-port manifold, and was established in the fuel electrode dispersedly Suppose that two or more purge piping distributed by the air inlet manifold and the fuel inlet-port manifold in the direction of a laminating of a single cel is attached in the laminating mold fuel cell power plant which generates power according to electrochemical reaction in a fuel cell layered product.

[0009] Furthermore, suppose that it constitutes from two or more piping equipped with the fluid resistance element which branches from a process line, for example, consists two or more above-mentioned purge piping of an orifice. Furthermore, suppose that two or more purge piping distributed in the direction of a laminating of a single cel is attached to an above-mentioned air-outlet manifold and an above-mentioned fuel outlet manifold.

[0010]

[Function] In a laminating mold fuel cell power plant, if two or more purge piping distributed in the direction of a laminating of a single cel is attached to the air inlet manifold and fuel inlet-port manifold which were built into the side face of a fuel cell layered product, in case operation of equipment will be suspended, the inert gas for inert gas replacement can be supplied to a fuel cell layered product from two or more purge piping. Since the difference of the fluid resistance of the passage which will be supplied to the single cel of the limited fraction which approaches from purge piping of one, and passes along each ** cel at this time since inert gas will be supplied for two or more purge piping distributed in the

direction of a laminating of a single cel at this time can be disregarded mostly, even if a flow rate is little, inert gas will be distributed to each ** cel almost equally, and will flow. Therefore, even if it stops low the flow rate of the whole inert gas distributed and supplied to this configuration, then two or more purge piping, inert gas replacement of each ** cel can be carried out almost equally.

[0011] Furthermore, if constituted from two or more piping equipped with the fluid resistance element which branches from a process line, for example, consists two or more purge piping of an orifice, even if it is in some from which the conditions of an outlet side differ, the flow rate of the inert gas which carries out splitting from a process line to each branch line can be made almost equal by adjusting resistance of a fluid resistance element. furthermore, only not only in an air inlet manifold and a fuel inlet-port manifold If two or more purge piping distributed in the direction of a laminating of a single cel by the air-outlet manifold and fuel outlet manifold which were similarly built into the side face of a fuel cell layered product is attached Since the die length of the passage from purge piping of the entrance side of inert gas to [be / it / under / single cel / passing] purge piping of an outlet side becomes almost the same about each ** cel and fluid resistance also becomes almost the same, the flow rate of the inert gas which flows each ** cel becomes almost equal.

[0012]

[Example] Hereafter, the example of this invention is explained using drawing. Drawing 1 is the perspective view showing the basic configuration of the fuel cell layered product incorporating the manifold in the 1st example of the laminating mold fuel cell power plant of this invention. The fuel cell layered product 1 currently displayed by unifying in drawing is with the fuel electrode equipped with two or more fuel gas conduction slots where the air pole equipped with two or more air conduction slots and an air conduction slot and passage cross an electrolyte layer at right angles like what was shown in drawing 4 , carries out two or more layer laminating of the plate-like single cel which it comes to pinch in the vertical direction of drawing, and is formed in the shape of a rectangular parallelepiped. The fuel inlet-port manifold 2 is built into one side of a side face in which the fuel gas conduction slot of the fuel cell layered product 1 carries out opening and which faces, and the fuel outlet manifold 3 is built into another side, and the air inlet manifold 4 is built into one side of the side face in which the others in which an air conduction slot carries out opening face similarly, and the air-outlet manifold 5 is built into another side. In case a laminating mold fuel cell power plant is operated, supply fuel gas from the fuel inlet-port nozzle 6 in which it was prepared by the fuel inlet-port manifold 2, the fuel gas conduction slot of each ** cel is made it to shunt and carry out conduction, and it discharges to the fuel outlet nozzle which was prepared in the fuel outlet manifold 3 and which is not illustrated. Moreover, supply oxidant gas, for example, air, to coincidence from the air inlet nozzle 7 in which it was prepared by the air inlet manifold 4, the air conduction slot of each ** cel is made it to shunt and carry out conduction to it, and it discharges to the air outlet nozzle which was prepared in the air-outlet manifold 5 and which is not illustrated. In case operation of a laminating mold fuel cell power plant is ended and it stops While suspending supply of the above-mentioned fuel gas and oxidizing agent gas, the inert gas obtained from the purge gas feeder which is not illustrated The fuel cell layered product 1 is supplied from two or more purge inlet-port piping 8A distributed in the direction of a laminating established in the fuel inlet-port manifold 2, and two or more purge inlet-port piping 8B which was prepared in the air inlet manifold 4 and which was similarly distributed in the direction of a laminating. After the inert gas supplied to two or more purge inlet-port piping 8A carries out conduction of the fuel gas conduction slot of each ** cel of the fuel cell layered product 1, it is discharged from the fuel outlet nozzle of the fuel outlet manifold 3. Moreover, after the inert gas supplied to two or more purge inlet-port piping 8B carries out conduction of the air conduction slot of each ** cel, it is discharged from the air outlet nozzle of the air-outlet manifold 5.

[0013] In this configuration, since it is supplied by two or more purge inlet-port piping 8A and 8B by which the inert gas for inert gas replacement was distributed in the direction of a laminating of a single cel, the single cel of the limited fraction which approaches from purge piping of one will be supplied, and even if a flow rate is little, inert gas will be distributed to each ** cel almost equally, and will flow. Therefore, inert gas replacement can be effectively performed by supplying the inert gas of a few flow rate using the purge gas feeder of small capacity.

[0014] Drawing 2 is drawing of longitudinal section showing typically the basic configuration of the fuel cell layered product incorporating the manifold in the 2nd example of the laminating mold fuel cell power plant of this invention. The difference with the 1st above-mentioned example of this example is in the point that piping for purge gas supply which consists of a purge inlet-port process line 14 and two or more branch pipes 12 equipped with the fluid resistance element 13 which branches from the purge

inlet-port process line 14, and consists of an orifice is prepared in the fuel inlet-port manifold 2, instead of purge inlet-port piping 8A of the 1st example. In this configuration, since the flow rate of the inert gas which adjusts the effect of the difference of the passage die length in the fuel outlet manifold 3 produced when it is collectively discharged from the fuel outlet nozzle 10 of the fuel outlet manifold 3 by the inert gas supplied from each branch pipe 12, or the difference of the potential head by the orifice, and carries out splitting from a process line to each branch line can be made almost equal, supply of the inert gas of a few flow rate can perform inert gas replacement more.

[0015] In addition, in the 2nd example shown in drawing 2 , although only the case where inert gas was supplied to the fuel inlet-port manifold 2 was illustrated, it is not necessary to illustrate that the same effectiveness is acquired, and it is clear by incorporating piping for purge gas supply with the same said of the case where the fuel inlet-port manifold 2 is supplied. Drawing 3 is the top view showing typically the basic configuration of the fuel cell layered product incorporating the manifold in the 3rd example of the laminating mold fuel cell power plant of this invention.

[0016] The difference between the 1st above-mentioned example of this example or the 2nd example is in the point that the fuel outlet manifold 3 is equipped with two or more purge outlet piping 9B by which purge inlet-port piping 8A and two or more purge outlet piping 9A similarly distributed in the direction of a laminating were distributed in the direction of a laminating as well as the air-outlet manifold 5 again. Moreover, with this configuration, two or more purge inlet-port piping 8A approaches the edge of the fuel inlet-port manifold 2, it is arranged, and two or more purge outlet piping 9A which faces is arranged at the point close to the edge of the opposite side of the fuel outlet manifold 3 which serves as mostly an installing point of purge inlet-port piping 8A with axial symmetry to the medial axis of the fuel cell layered product 1. Moreover, similarly, two or more purge inlet-port piping 8B approaches the edge of the air inlet manifold 4, it is arranged, and two or more purge outlet piping 9B which faces is arranged at the point close to the edge of the opposite side of the fuel outlet manifold 5 which serves as mostly an installing point of purge inlet-port piping 8A with axial symmetry to the medial axis of the fuel cell layered product 1.

[0017] With this configuration, since the purge inlet-port piping 8A and 8B and the purge outlet piping 9A and 9B distribute in the direction of a laminating of a single cel and are arranged by each in it, about each passage of the direction of a laminating of a single cel, it becomes almost the same, and the passage die length from the inlet port of inert gas to an outlet distributes in the direction of a laminating almost equally, and carries out conduction of the inert gas to it. Furthermore, since the purge inlet-port piping 8A and 8B and the purge outlet piping 9A and 9B approach the edge of each manifold and are mostly arranged to the medial axis of the fuel cell layered product 1 at axial symmetry The passage die length of the flowing inert gas two or more fuel gas circulation slots or air conduction slots which have been arranged in the field of each ** cel at juxtaposition Since it becomes almost the same as the dotted line which attached the thin line which attached the arrow head all over drawing, or the arrow head showed, it will distribute into two or more conduction slots of each ** cel almost equally, and conduction of the inert gas will be carried out to them. Thus, since inert gas carries out conduction to each passage almost equally with this configuration, even if it stops the flow rate of the inert gas to supply a little, inert gas replacement of the interior of the fuel cell layered product 1 can be carried out efficiently.

[0018]

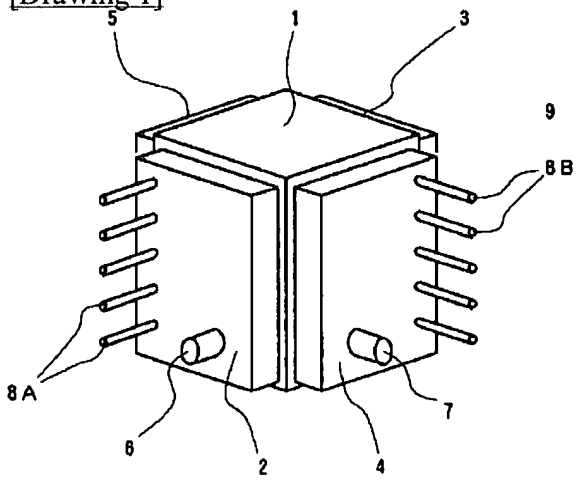
[Effect of the Invention] As mentioned above, according to this invention, carry out the laminating of two or more single cels which come to pinch an electrolyte layer with an air pole and a fuel electrode, and a fuel cell layered product is formed. On the side face of the pair of a fuel cell layered product, an air inlet manifold and an air-outlet manifold A fuel inlet-port manifold and a fuel outlet manifold are built into the side face of other pairs. After carrying out conduction to the air conduction slot which supplied oxidant gas from the air inlet manifold, and was established in the air pole dispersedly, it discharges from an air-outlet manifold. By discharging from a fuel outlet manifold, after carrying out conduction to the fuel gas conduction slot which supplied fuel gas to coincidence from the fuel inlet-port manifold, and was established in the fuel electrode dispersedly In the laminating mold fuel cell power plant which generates power according to electrochemical reaction in a fuel cell layered product Since two or more purge piping distributed in the direction of a laminating of a single cel is attached to an air inlet manifold and a fuel inlet-port manifold The inert gas for inert gas replacement supplied in case operation of equipment is suspended Since it distributes in the single cel of the limited fraction which approaches from purge piping of one almost equally, conduction is carried out to it and inert gas replacement of each ** cel is carried out almost equally The laminating mold fuel cell power plant which can carry out inert gas replacement of the single cel of a large number which constitute a fuel cell

layered product equally by the conduction of little purge gas will be obtained.
[0019] Furthermore, if constituted from two or more piping equipped with the fluid resistance element which branches from a process line, for example, consists of an orifice two or more above-mentioned purge piping attached to the air inlet manifold and the fuel inlet-port manifold Since the flow rate of the inert gas which carries out splitting from a process line to each branch line by adjusting resistance of a fluid resistance element can be made almost equal even if it is in some from which the conditions of an outlet side differ It is suitable as a laminating mold fuel cell power plant which can carry out inert gas replacement of the single cel of a large number which constitute a fuel cell layered product equally by the conduction of little purge gas.
[0020] Furthermore, since the die length of the passage from attaching two or more purge piping distributed in the direction of a laminating of a single cel also to an above-mentioned air-outlet manifold and an above-mentioned fuel outlet manifold, then purge piping of the entrance side of inert gas to [be / it / under / single cel / passing] purge piping of an outlet side becomes almost the same about each ** cel and fluid resistance also becomes almost the same, the flow rate of the inert gas which flows each ** cel becomes almost equal. Therefore, it is more suitable as a laminating mold fuel cell power plant which can carry out inert gas replacement of the single cel of a large number which constitute a fuel cell layered product equally by the conduction of little purge gas.

[Translation done.]

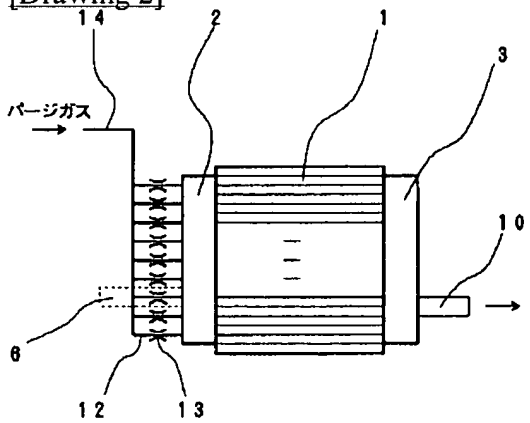
DRAWINGS

[Drawing 1]



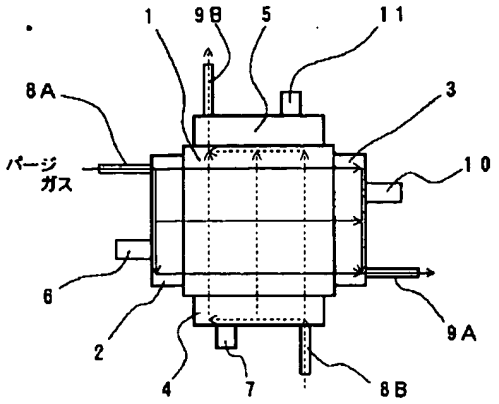
1 … 燃料電池積層体
2 … 燃料入口マニホールド
3 … 燃料出口マニホールド
4 … 空気入口マニホールド
5 … 空気出口マニホールド
6 … 燃料入口ノズル
7 … 空気入口ノズル
8A … パージ入口配管
8B … パージ入口配管

[Drawing 2]



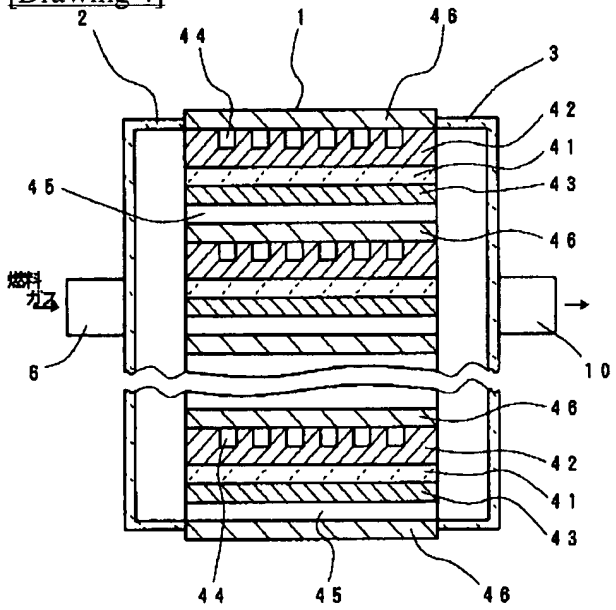
1 … 燃料電池積層体
2 … 燃料入口マニホールド
3 … 燃料出口マニホールド
6 … 燃料入口ノズル
10 … 燃料出口ノズル
12 … 分岐管
13 … 流体抵抗要素
14 … パージ入口主配管

[Drawing 3]



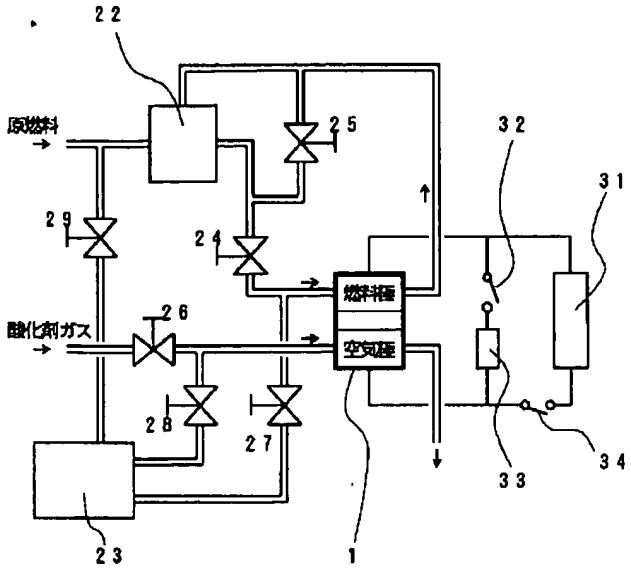
1 …燃料電池積層体
2 …燃料入口マニホールド
3 …燃料出口マニホールド
4 …空気入口マニホールド
5 …空気出口マニホールド
6 …燃料入口ノズル
7 …空気入口ノズル
8A …パージ入口配管
8B …パージ入口配管
9A …パージ出口配管
9B …パージ出口配管
10 …燃料出口ノズル
11 …空気出口ノズル

[Drawing 4]



1 …燃料電池積層体
2 …燃料入口マニホールド
3 …燃料出口マニホールド
6 …燃料入口ノズル
10 …燃料出口ノズル
41 …電解質層
42 …空気極
43 …燃料極
44 …空気通流溝
45 …燃料ガス通流溝
46 …分離板

[Drawing 5]



1 …… 燃料電池積層体
22 …… 改質装置
23 …… パージガス供給装置
24 …… 燃料供給弁
25 …… バイパス弁
26 …… 酸化剤供給弁
27 …… 燃料系パージ弁
28 …… 酸化剤系パージ弁
29 …… 改質系パージ弁
31 …… 外部負荷
32 …… 放電抵抗接続器
33 …… 放電抵抗
34 …… 外部負荷接続器

[Translation done.]